

CHAPTER 2

THE STUDY AREA

The Maputaland Centre of Plant Endemism has been defined as that part of southern Mozambique and northeastern KwaZulu-Natal in South Africa, bounded in the north by the Inkomati-Limpopo River, in the east by the Indian Ocean, in the west by the western foothills of the Lebombo Mountains and in the south by the St. Lucia estuary (Van Wyk 1994). Figure 1 shows the location of the study area in South Africa and Mozambique. Within the Maputaland Centre of Plant Endemism, the present study was conducted in and around the Tembe Elephant Park (27°01'S 32°24'E) on the southern Mozambique Coastal Plain. The park extends over an area of 30 013 ha with the northern limit being the international boundary between South Africa and Mozambique. It falls within the Tembe Tribal Ward. The southern border of the park is on the main tarred road from Jozini to KwaNgwanase, the eastern border on the eastern side of the security road which runs from the tarred road to the Mozambique border, and the western border on the Mbangweni Corridor, an area forming a gap of approximately 5,5 km between Tembe Elephant Park and the Ndumo Game Reserve. Future plans are to link the two reserves by incorporating this corridor (KwaZulu-Natal Nature Conservation Services 1997). Although the Tembe Elephant Park was proclaimed in 1983, the international boundary with Mozambique was only fenced off in 1989, effectively stopping the movement of large animals in and out of the area (Matthews *et al.* 2001). The boundaries are all fenced with wildlife-proof fencing consisting of 2,1 m veldspan with 3 or 4 barbed wire strands on top. On the inside of the main game fence runs an electric stopper fence that is 1,4 m high, consisting of 4 strands of electrified wire (KwaZulu-Natal Nature Conservation Services 1997).

Until recently, this area was relatively undeveloped with little human influence. Few people have lived historically in this area because of the scarcity and seasonality of surface water. Soils in the region are also generally too nutrient-poor for cultivation, except next to the Muzi Swamp along the eastern border of the park. The density of people along the Muzi Swamp has always been low, however, because sections of the swamp can be dry for some months of the year, and the more permanent water of the northern sections of the Muzi Swamp are saline with salinity gradients of 0.5 to 5% (Matthews *et al.* 2001).

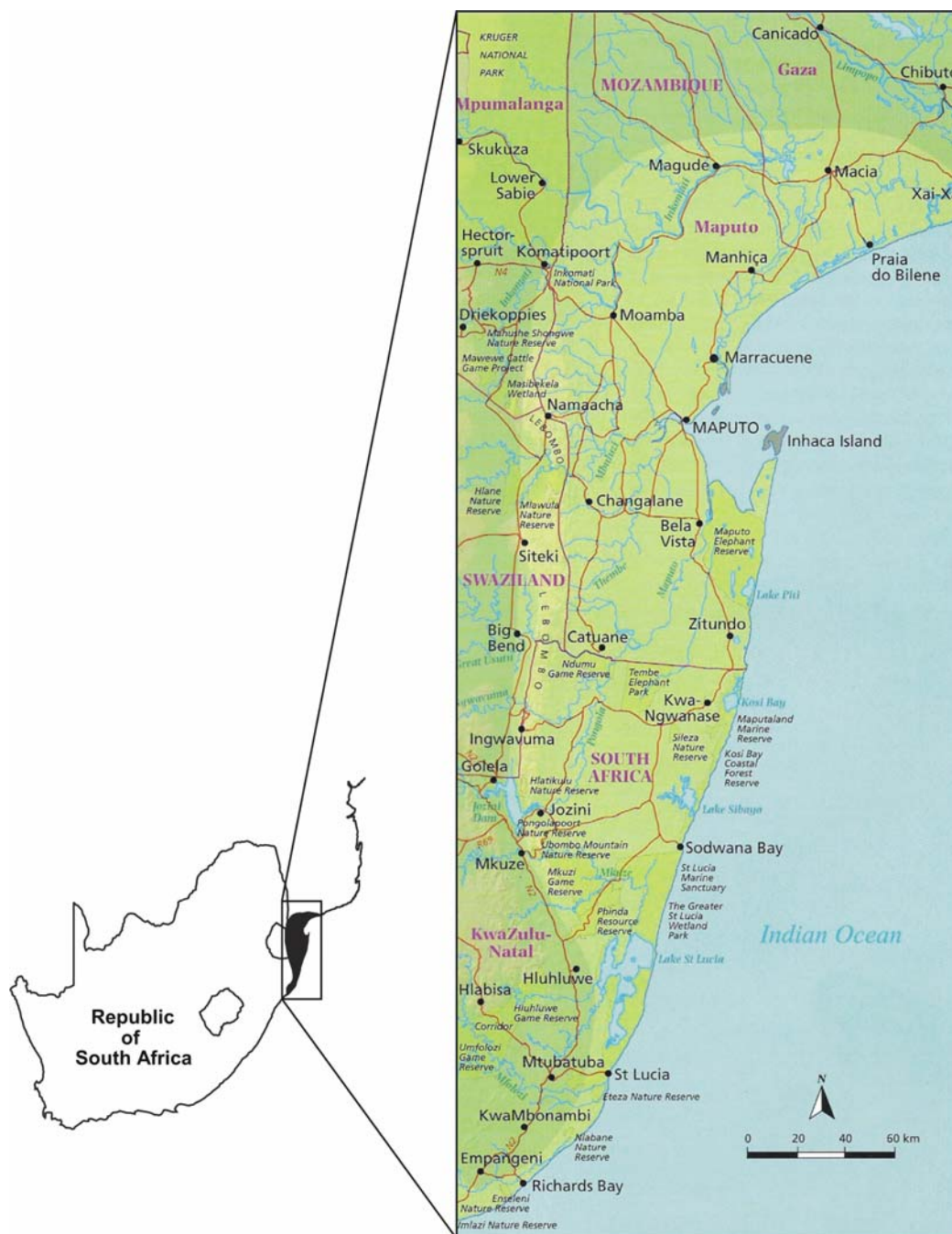


Figure 1: The location of the Maputaland Centre of Plant Endemism (highlighted in light green) within South Africa and Mozambique as adapted from Van Wyk & Smith (2001).

The reasons for the proclamation of the Tembe Elephant Park were to:

- Protect the lives and property of the local people from damage and injury by elephants *Loxodonta africana*.
- Preserve the last naturally occurring population of the African elephant in KwaZulu-Natal.
- Protect one of the largest populations of Livinstone's Suni *Neotragus moschatus* in southern Africa, as well as other wildlife species that occur in the area.
- Preserve and protect the unique Sand Forest. This habitat type is not well represented in other conservation areas within southern Africa. Many species of fauna and flora reach their southernmost distribution in the portion of the Mozambique Coastal Plain covered by the park (KwaZulu-Natal Nature Conservation Services 1997).

In 1989 the KwaZulu Department of Nature Conservation decided that the administration of the Tembe Elephant Park and the Ndumo Game Reserve should be amalgamated and rationalized. This was done to eliminate costly duplications in the administrative structures, and to facilitate the physical link-up of the two reserves via the Mbangweni Corridor. Law enforcement and security matters were linked in January 1990, followed by financial matters in April 1990, and a complete hand over was accomplished in June 1990 (KwaZulu-Natal Nature Conservation Services 1997).

The future vision for the area are primarily:

- To ensure the maintenance and conservation of existing habitat types, their diversity and associated faunas; to maintain viable populations of all species. In Tembe Elephant Park, special emphasis will be placed on Sand Forest / Sandveld thicket habitats and their associated flora and fauna.
- To maintain, via environmentally acceptable programmes and judicious zoning, these habitat types.

The secondary objectives are:

- To allow controlled use of those natural resources which may be harvested on a sustained yield basis.
- To encourage scientific research, especially that which has as its emphasis the solving of management-oriented problems.

- To encourage and promote environment education programmes relevant to the Complex.
- To ensure that development and financial priorities are determined and adequate planning takes place in an endeavour to obtain finances for the efficient establishment and running of chosen projects relevant to the area.
- To encourage economically viable visitor use of the Complex, which is controlled in such a way that it is in harmony and compatible with the primary objectives and overall policies of the KwaZulu-Natal Nature Conservation Service (KwaZulu-Natal Nature Conservation Services 1997).

TOPOGRAPHY

The Maputaland Centre of Plant Endemism lies on a nearly flat low-level coastal plain with a maximum elevation of about 150 m, except for the narrow Lebombo mountain range on the western boundary, rising to an elevation of 600 m (Van Wyk & Smith 2001). At the coast on the eastern boundary, the sea is separated from the land by high coastal dune ridges, which are considered to be among the highest vegetated dunes in the world. The land immediately behind the dunes is flat, containing some extensive wetlands, particularly marshes, lakes and estuaries. The central part of the coastal plain is covered by gently undulating sand dunes, with the Muzi Swamp some 40 km from the coast, running roughly parallel with the shoreline. As one moves further inland, the Pongola River, with its broad floodplain and associated pans, is reached just before the foothills of the Lebombo Mountains (Moll 1977).

The Tembe Elephant Park lies at the southernmost portion of the broad Mozambican Coastal Plain. The topography within the park is defined by high, linear, north-south oriented dune cordons with poorly preserved parabolic dunes superimposed on the surface (Matthews *et al.* 2001). Where the soil clay content is high, perennial pans may form in the depressions between the dune ridges. The two highest dune ridges of the Coastal Plain are Nhlela Ridge and Beacon Ridge in the park, both reaching a height of 129 m above sea level. The lowest-lying area in the park is the Muzi Swamp on the eastern side at approximately 50 m above sea level (Matthews *et al.* 2001).

GEOLOGY AND SOILS

Resistant volcanic rhyolitic lavas (Figure 2) form the Lebombo Mountain Range, while the broad Mozambican Coastal Plain consists mainly of Cretaceous Siltstone units (Van Wyk 1996; Van Wyk & Smith 2001). Since the break-up of Gondwanaland started, some 140 million years ago, the Mozambican Coastal Plain has been affected by a number of marine transgressions, which deposited, eroded and reworked a variety of fossiliferous sands, silts and clays (Watkeys *et al.* 1993). High dune cordons, which can be traced for long distances along the inland margins of the coastal zone, mark periods without transgression during the Mio-Pliocene marine regressions. The oldest dune ridges date back approximately 3 million years to the early Pleistocene, whereas the youngest are probably from the late Pleistocene and are around 10 000 years old. The latter are some of the youngest formations present in southern Africa (Matthews *et al.* 2001; Van Wyk & Smith 2001).

A fertile clayey alluvium occurs in the floodplains of some of the larger rivers (Bruton & Cooper 1980). The oldest Plio-Pleistocene weathering profiles are red and dominant in the western areas or in localised places where old sands rise above the surrounding deposits. Lesser-developed, yellowish and grey profiles formed in younger redistributed sands during the Pleistocene and Holocene and occur in degraded dune fields or areas dominated by a high water table. In the permanent swamps, thick peat deposits have accumulated while calcrete deposits have formed adjacent to the Muzi Swamp (Matthews *et al.* 2001).

Soils over most of the Mozambican Coastal Plain are infertile, homogeneous, grey, siliceous, aeolian sands that are highly leached (dystrophic) and relatively acidic with a water pH \approx 6.1 (Matthews *et al.* 2001; Van Wyk & Smith 2001). Within Tembe Elephant Park, the soils typically have a thin organically enriched A-horizon underlain by a sandy subsoil. The higher dune ridges in the park consist of high base status soils, while regic sands dominate the surrounding lower areas. Clay content of the soils within the park is linked to the intensity of weathering of labile minerals over a long period (Matthews *et al.* 2001).

Well-drained profiles characterised by deep, red or yellowish soils are found on the high topographical areas like the Nhlela and Beacon Ridges in the park. These areas also have the steepest gradients and short hill slopes, and the soils have less than 5% clay. Soils on these ridges are classified as Hutton (orthic A-horizon; red apedal B-horizon) or Clovelly Forms (orthic A-horizon; yellow-brown apedal B-horizon) according to the South African system (Soil Classification Working Group 1991; Matthews *et al.* 2001). Land types representing these areas are Ae151 and Ah30 (Figure 3).

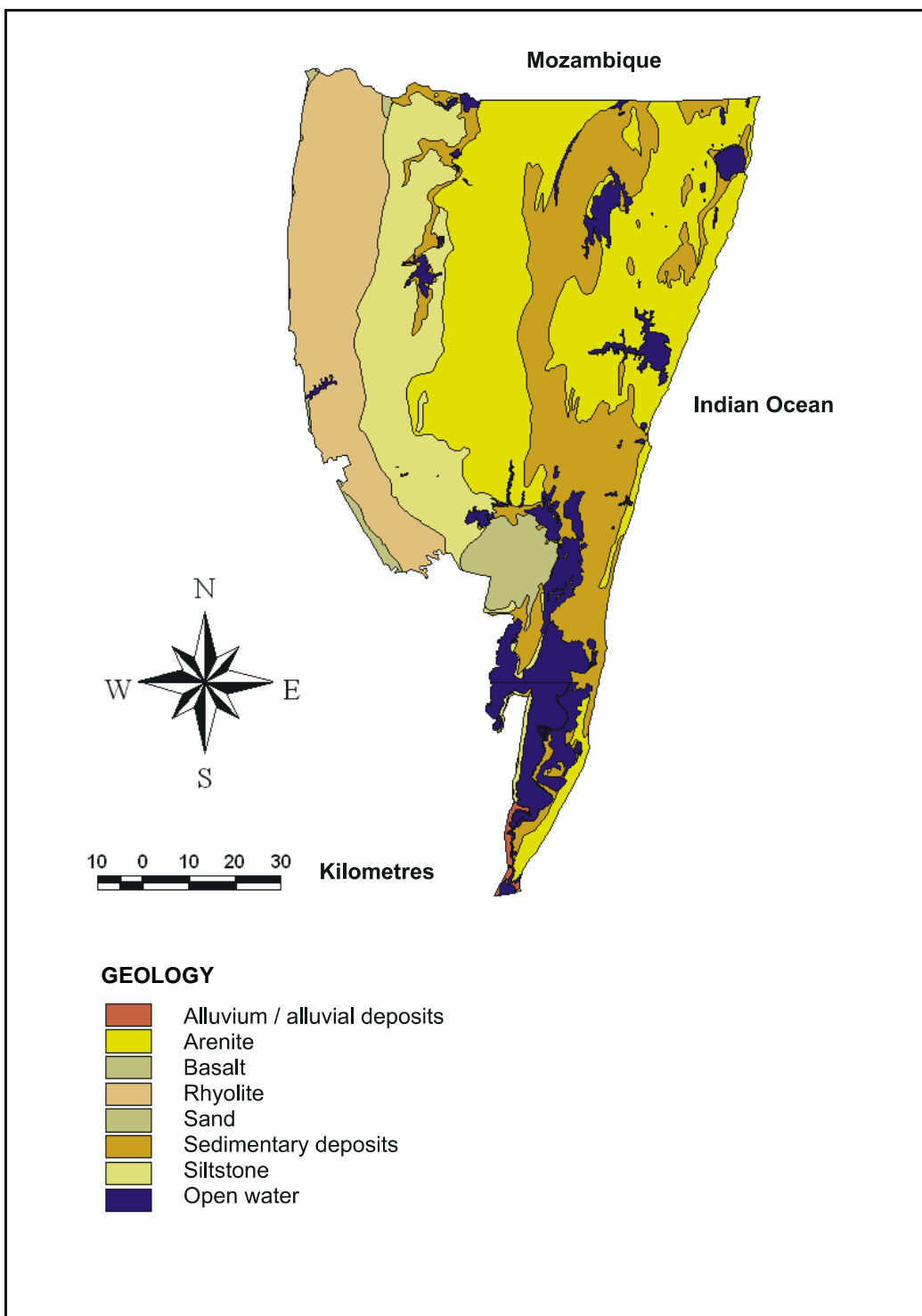


Figure 2: The Maputaland Centre of Plant Endemism in South Africa, showing the location of the different geological formations.

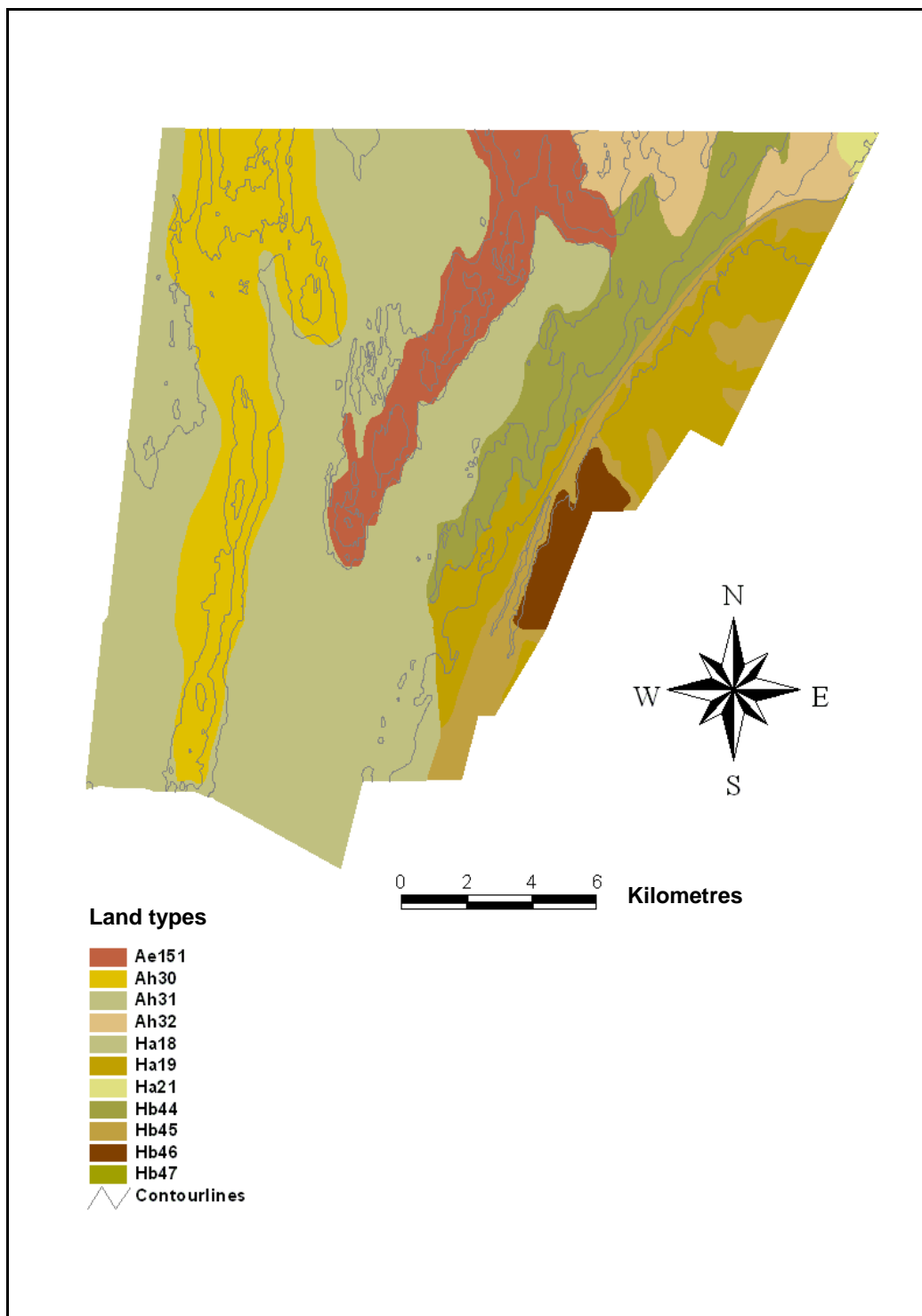


Figure 3: Tembe Elephant Park, South Africa showing the location of the different land types.

Degraded lower dunes are characterised by sandy profiles with yellowish brown or light grey subsoil horizons. The gradient in these areas is low with long slopes, while the profiles are moderately to well drained, although high water tables within low-laying interdune depressions result in bleached, grey soil profiles. The soils in these areas are yellowish Clovelly or grey Fernwood Form (orthic A-horizon; E-horizon) soils (Soil Classification Working Group 1991; Matthews *et al.* 2001). Land types representing these areas are Ah31; Ah32; Ha18; Ha19; Ha21 and Hb46 (Figure 3).

Low-laying areas with lateral ground water migration have resulted in the formation of clay-rich, slightly saline or calcareous duplex soils. Where the dune sands border on the Muzi Swamp it has led to the formation of sodic Estcourt Form (orthic A-horizon; E-horizon; prismatic B-horizon) soils with prismatic subsoil structures. The Muzi Swamp is characterised by gleying conditions with peat formation resulting in Champagne Form (organic O-horizon) soils (Soil Classification Working Group 1991; Matthews *et al.* 2001). Land types representing these areas are Hb44; Hb45 and Hb47 (Figure 3).

CLIMATE

The Maputaland Centre of Plant Endemism lies at the southern end of the tropics in Africa, and a tropical/subtropical climate prevails with no frost in the winter (Van Wyk 1996; Van Wyk & Smith 2001). This centre lies within the summer rainfall area with a mean annual rainfall of 1000 to 1500 mm at the coast, decreasing rapidly towards the interior (Moll 1977). The driest part is in the Pongola region, where the mean annual rainfall is as low as 500 to 600 mm. The crest of the Lebombo Mountain Range receives 800 to 1000 mm of rain per year (Bruton & Cooper 1980).

Winter mist is quite common on the Lebombo Mountain Range, and on the plains through inversion. Relative humidity is also generally high, even away from the coast (Van Wyk & Smith 2001). The temperature is generally hot throughout the year, but higher in the central regions than at the coast (Moll 1977). The Maputaland Centre of Plant Endemism is thus not characterised by four distinctive seasons but rather mostly only by two, summer and winter, due to the nature of the climatic conditions associated with the region (Schulze 1982; Matthews *et al.* 2001).

Rainfall and temperature data for the weather station at Sihangwana (E 32° 25' 25"; S 27° 02' 35"), situated at the main entrance gate of the Tembe Elephant Park, are shown in Figure 4. The mean annual rainfall for the park is 721.5 mm, with the minimum recorded annual rainfall being 245.0 mm and the maximum 2105.0 mm. Although rainfall is spread throughout the year, the summer months are the wettest and winter months the driest. The relative humidity of the air in the park is also higher

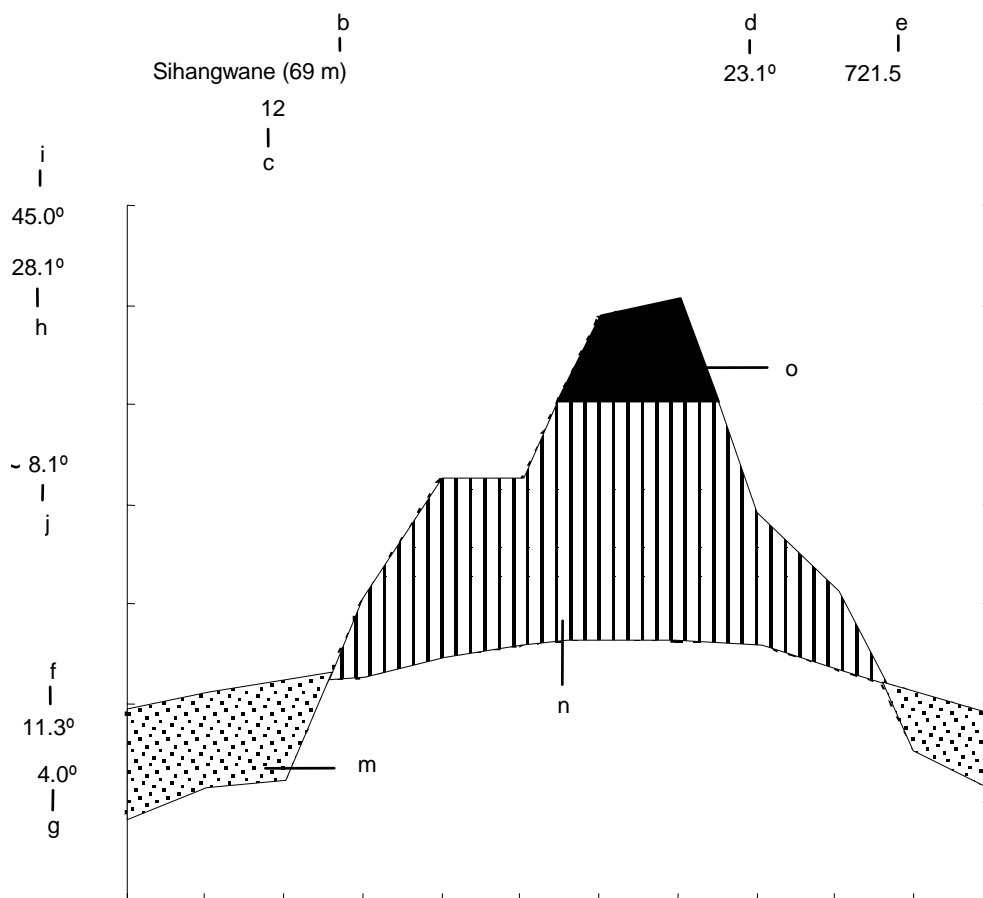


Figure 4: Climatogram of Sihangwane Weather Station, Tembe Elephant Park, following Walter (Cox & Moore, 1994). b = height above sea-level in m; c = duration of observations in years; d = mean annual temperature in °C; e = mean annual precipitation in mm; f = mean daily minimum temperature of the coldest month; g = lowest temperature recorded; h = mean daily maximum temperature of the warmest month; i = highest temperature recorded; j = mean daily temperature variation; m = relative period of drought; n = relatively humid season; o = mean monthly rainfall > 100 mm (Tarr *et al.* 2004).

during the summer (91%) than during the winter (40%). Morning mist is common, especially around the Muzi Swamp, during the winter (Matthews *et al.* 2001). The mean annual temperature recorded for the park is 23.1°C, with temperatures ranging from an extreme minimum of 4°C to an extreme maximum of 45°C (Tarr *et al.* 2004).

VEGETATION

The vegetation of the Maputaland Centre of Plant Endemism is diverse, with at least 15 broad vegetation types described for the KwaZulu-Natal portion of the region, including different types of grassland, bushveld, thicket, forest and swamp vegetation (Moll 1977). Two remarkable vegetation types, the Sand Forest and the Woody Grassland, are endemic to the region (Van Wyk & Smith 2001). The Sand Forest is characterised by a unique combination of plant and animal species and has the highest diversity of woody plant species in the region, with a significant number of these being endemic to the Maputaland Centre of Plant Endemism (Everard *et al.* 1994; Matthews *et al.* 2001). Quantitative evidence suggests that most of the endemic vertebrate species in the Maputaland Centre of Plant Endemism are likewise restricted to this habitat type (Van Wyk 1996; Van Rensburg *et al.* 2000).

The Tembe Elephant Park lies within the core area of the Maputaland Centre of Plant Endemism (Figure 1) and contains the largest protected portion of Sand Forest in South Africa (Van Rensburg *et al.* 1999, 2000; McGeoch *et al.* 2002). Nine vegetation types were recognised by Matthews *et al.* (2001) within the Tembe Elephant Park. These are the *Acacia borleae* Shrubland/Bush Clump Mosaic on clay, Closed Woodland/Thicket Mosaic on sand, Closed Woodland on clay, Hygrophilous Grassland, Muzi Swamp, Old Lands, Open Woodland, Sand Forest/Grassland Mosaic and Sparse Woodland (Figure 5).

The *Acacia borleae* Shrubland/Bush Clump Mosaic on clay occurs next to marshy areas and clay-based thickets associated with the Muzi Swamp. In structure this vegetation type varied from areas of dense vegetation to thickets that were associated with termitaria. Abundant plant species are the grasses *Eragrostis heteromera* and *Eragrostis plana*, and the shrub *Acacia borleae*. Moreover, perennial pans were found interspersed throughout these clay areas. This vegetation type covered only 0.7% of the park (Matthews *et al.* 2001).

The Closed Woodland/Thicket Mosaic on sand occurs on the dune crests, slopes and interdune depressions throughout the Tembe Elephant Park and could be distinguished based on plant density, which varied from closed to semi-closed crown gaps and a canopy that varied from approximately 8 to 12 m in height. Abundant plant species are the shrubs *Euclea natalensis*, *Grewia caffra*, *Catunaregam spinosa*

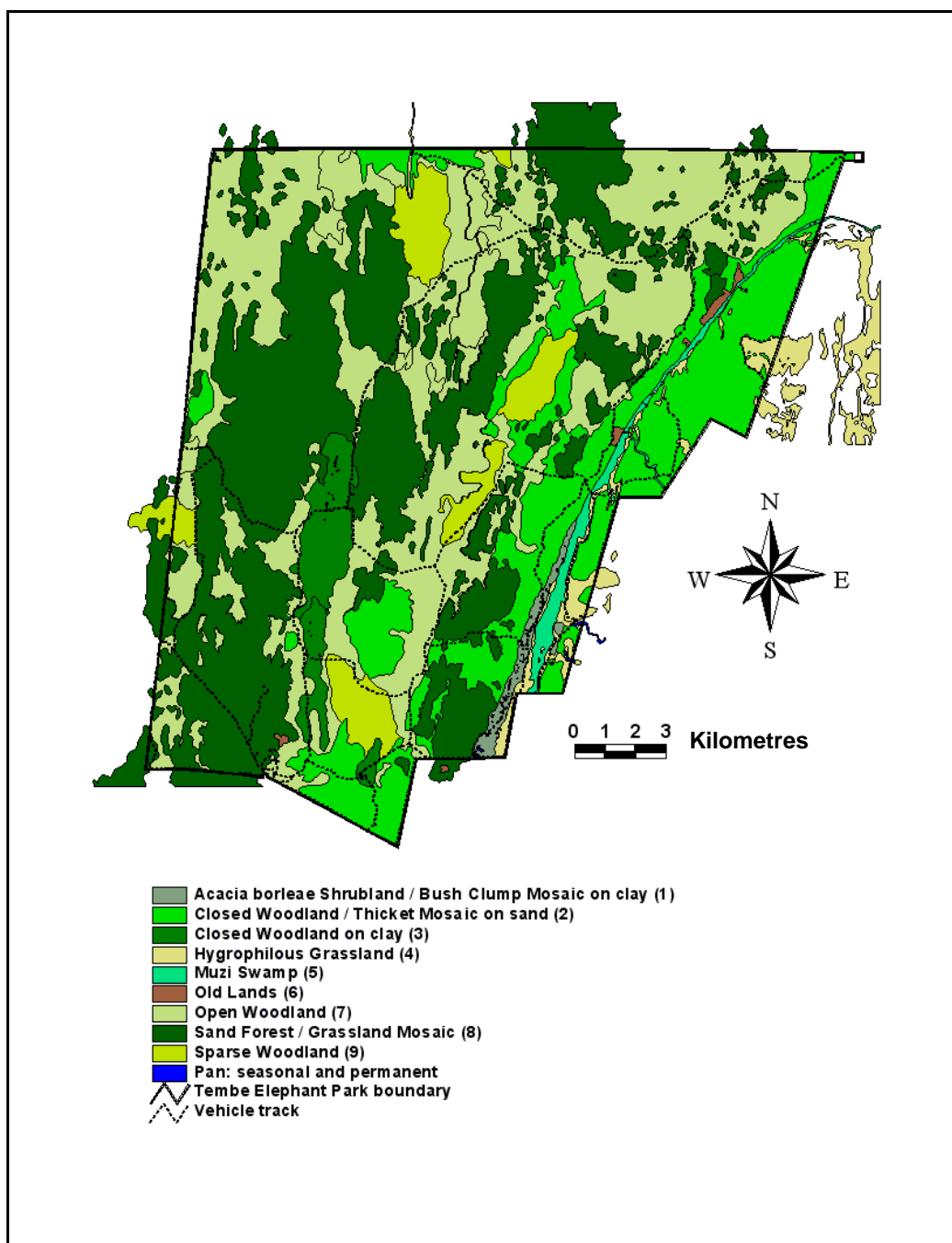


Figure 5: Tembe Elephant Park, South Africa showing the location of the different vegetation types based on Matthews *et al.* (2001).

and *Bridelia cathartica*, and the tree *Acacia burkei*. This vegetation type covered 15% of the park (Matthews *et al.* 2001).

The Closed Woodland on clay occurs on clay-rich duplex soils that are normally associated with the bottomlands of the dunes and the edges of the Muzi Swamp. Perennial pans were also found throughout this vegetation type, often as the result of mud wallows used by wildlife. Abundant plant species are the trees *Spirostachys africana*, *Berchemia zeyheri* and *Mystroxyton aethiopica*. This vegetation type covered 2.5% of the park (Matthews *et al.* 2001).

The Hygrophilous Grassland, found adjacent to the Muzi Swamp, had a grassland structure with only scattered trees or thickets. Abundant plant species are the grasses *Imperata cylindrica*, *Eragrostis lappula*, *Dactyloctenium geminatum*, *Panicum genuflexum* and *Eragrostis heteromera* and the shrub *Acacia nilotica* (Matthews *et al.* 2001). None of these grass species present has a high grazing value and therefore the grasses are generally poorly utilised by grazers (Van Oudtshoorn 1999). This vegetation type covered 2.0% of the park (Matthews *et al.* 2001). The Muzi Swamp consists of reed beds in an extensive swamp system that crosses the eastern side of Tembe and extends northwards to Maputo Bay in Mozambique. It is a well-described community that is associated with water bodies throughout South Africa. Abundant plant species were dense stands of *Phragmites australis*, mixed with *Typha capensis* in some areas (Matthews *et al.* 2001). Controlled reed harvesting by some of the local communities living adjacent to the park is currently allowed in the Muzi Swamp within the park (Tarr *et al.* 2004). The Muzi Swamp represents the only natural source of permanent water within the park, even in the driest years. This vegetation type covered 1% of the park (Matthews *et al.* 2001).

The Old Lands comprised only 0.2% of the total available habitat in the Tembe Elephant Park. Since the proclamation of the park more than 10 years ago, these areas have recovered to the point that they are no longer distinguishable in the field and no distinctive description is available. The small size of this vegetation type furthermore renders it futile to discuss in terms of its effects on management decisions.

The Open Woodland was the second largest vegetation type in Tembe and occurs on the dune crests, slopes and interdune depressions throughout the park. This vegetation type is characterised by a good grassy layer interspersed with a few tall trees of approximately 8 to 10 m in height. Grass species abundant in the Open Woodland included several species with a high grazing value such as *Andropogon gayanus*, *Panicum maximum* and *Digitaria eriantha* (Van Oudtshoorn 1999;

Matthews *et al.* 2001). Abundant trees in this vegetation type included *Albizia versicolor*, *Strychnos madagascariensis*, *Combretum molle*, and *Terminalia sericea*. This vegetation type covered 26.6% of the park (Matthews *et al.* 2001).

The Sand Forest/Grassland Mosaic was the largest vegetation type in Tembe and was mostly associated with dunes. This vegetation type was structurally classified as a forest and had a poorly developed understory that is interspersed with grassland (Matthews *et al.* 2001). The forest had, in some instances, a low canopy of approximately 5 m high and in other areas extending up to approximately 15 m high. The grasslands there were open with few to no trees and shrubs, and it gradually acquired a more open woodland character further away from the Sand Forest. Abundant plant species included the forbs *Indigofera inhambanensis* and *Trachyandra cf. salti*, the grasses *Bewsia biflora*, *Urelytrum agropyroides* and *Perotis patens*, and the sedge *Cyperus obtusiflorus*. This vegetation type covered 47.9% of the park (Matthews *et al.* 2001).

The Sparse Woodland mainly occurs on the flat areas between the dunes, but also to a lesser degree on the dune slopes and crests throughout Tembe (Matthews *et al.* 2001). This vegetation type is in effect grassland that is characterised by an abundance of shrub species that produced annual leafy and flowering shoots from a perennial, underground woody rootstock and has few large trees. Abundant plant species are the grasses *Trichoneura grandiglumis* and *Panicum kalahareense*, the geoxylic-suffrutex *Parinari capensis* subsp. *Incohata*, and the tree *Terminalia sericea*. This vegetation type covered 4.2% of the park (Matthews *et al.* 2001).

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